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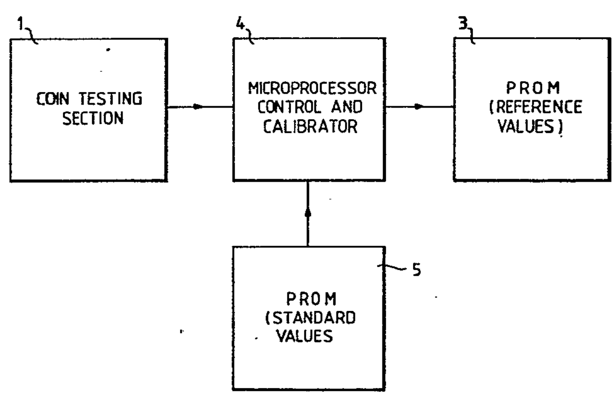
(54) A method and apparatus for calibrating a coin validation apparatus.

(57) A method of calibrating a coin validation apparatus including a coin testing section (1) and a programmable memory (3) comprises subjecting two tokens successively to a coin test using the coin testing section (1) to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section (1). These determined parameter values for the two tokens are then compared with standard values of the parameter signals for the two tokens, and from the determined parameter values and the standard values, calibration factors relevant to that particular coin testing section (1) are computed. Standard values of the parameter signals for a set of coins to be used with the coin validation apparatus are then operated on using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section (1). Finally, the programmable memory (3) is programmed with these computed individual reference values. An apparatus for performing this method includes two tokens, a programmed memory (5) containing standard values of the parameter signals for the said two tokens and standard values for coins acceptable to the validation apparatus, and a programmed computer (4).



EP 0 072 189 A2

Aeronautical & General Instruments P.L.C. 80/2008/02

A METHOD AND APPARATUS FOR CALIBRATING A COIN VALIDATION APPARATUS

Coin validation apparatus may be associated with a coin freed mechanism on a variety of coin receiving machines such as coin box telephones or vending machines or may form part of a coin sorting apparatus to check that coins are valid coins and not counterfeit. There are many different types of coin validation apparatus in use, but recently, with the introduction of modern electronic devices to control the operation of the coin receiving machines and sorting apparatus, it has become particularly convenient to use the interaction between a coin and an alternating magnetic field to gauge various parameters of the coin thereby to determine if the coin is valid.

Our co-pending European Patent Application No 82301161.4 describes a particularly convenient form of coin validation apparatus comprising a coin testing section, a microprocessor which controls the operation of the apparatus and analyses the output of the coin testing section, and a programmable memory containing the individual reference values for valid coins. The coin testing section includes an electrical coil through which, in use, an alternating current is fed to produce an alternating magnetic field and a coin to be tested is placed adjacent the coil in the alternating magnetic field. The coin testing section produces two parameter signals which are characteristic of the effect of the coin on both the inductance and the loss factor of the coil. With such an apparatus, these two parameter signals are then compared with reference values from the programmable memory by the microprocessor to determine if the coin is valid. However, the particular parameter signals that are generated by the coin testing section also depend to

some extent, upon the particular component values, tolerances, physical sizes, and location of the elements making up the coin testing section and thus, the exact value of the signal that indicates a valid coin in one coin testing section is likely to be different from the exact value of the signal in a different but similar piece of apparatus. The present invention is concerned with a method and an apparatus for calibrating the coin testing sections of such electronic coin validation apparatus to determine the appropriate reference values for the parameter signals that are characteristic of the effect of the coin on the coin testing section.

At present such calibration is performed by inserting a typical coin of the appropriate denomination into the coin test section and then subjecting it to a test. The values of the particular parameters that are obtained as a result of this test are then programmed into the memory and subsequently this stored value is used as the reference value of that parameter for coins of that denomination.

Naturally there is some spread in the parameters of valid coins. This spread results from tolerances in their manufacture and also from differences caused by wear in use. When a coin validator is calibrated using a typical coin a large number of valid coins of a particular denomination have to be sampled and then a coin is chosen as having representative parameters when its parameters are in the middle of the sample parameter distribution. It is then this representative coin that is used as the standard with which the apparatus is calibrated. Thus, supposing the apparatus is intended to accept 5p, 10p, and 50p coins, a representative coin of each denomination has to be found and then these coins are fed into the apparatus and the particular parameter signals produced by them used to program the memory and

hence calibrate the apparatus. Thus, in future, the apparatus compares every coin inserted into it with these particular parameters and if the coin has the same parameters or is very close to these parameters, the apparatus recognises it as a valid coin of a particular denomination.

There are many disadvantages with this system of calibration. It is difficult and time consuming to find representative coins having typical parameter values falling in the middle of a sample distribution of parameter values for valid coins of a particular denomination. Then, having located such a representative coin it is impossible to identify or label it without changing its parameters. Thus, once a representative coin has been found it is undistinguishable from any other coin by simple visual observation and consequently it is very easy for that representative coin to be mislaid or exchanged for a non-representative coin without anyone being aware of that fact. If this occurs then this naturally leads to errors in subsequent calibrations. Further, a separate calibration has been performed with a standard coin of each denomination with which the apparatus is to be used. This increases the difficulty in finding and then keeping distinct, appropriate representative coins. Naturally, after any replacement or repair to the coin testing section of the apparatus it has to be recalibrated and consequently it is desirable to be able to calibrate the apparatus on site with some easily portable reference or references. If this is to be done with representative coins firstly a large number of such coins have to be found and then strict control has to be exercised over all of them to ensure that they are not exchanged for other visually similar but not representative coins. In practice this has been found to create great difficulties.

It has also been proposed to use tokens, with the same parameters as representative coins, as the references with which the apparatus is calibrated. This has the advantage that the tokens would be identifiable but it is extremely difficult to manufacture such tokens to ensure that they have the same characteristics as valid representative coins. Such tokens also have to be prepared for all denominations of coins in the coin set to be used with the apparatus and for all of the coins in the various different currencies with which the apparatus may be used.

The particular values of the two parameters characteristic of the valid coin of each particular denomination can be thought of as points, on a two dimensional graph with the two parameters forming the axes of the graph. In the example referred to above the axes would be the inductance and loss factor of the coil and thus, for each denomination of coin there would be a particular point on this graph having particular co-ordinates for both inductance and loss factor. It is the co-ordinates of this particular point which form the reference values for a particular denomination of coin. In practice, because of the spread in the characteristics of valid coins caused by such things as wear what needs to be determined are the co-ordinates of a small area on the graph representing the acceptable range in parameter values for acceptable coins. Naturally, the particular location of the points or small areas on such a graph which represent the reference values vary from one coin testing section to another depending upon the idiosyncracies of the individual elements in the coin testing section. However, we have discovered that the differences between the locations of such reference points in different pieces of apparatus can be represented and taken account of by moving the origin of the axes and

by applying a scaling factor to each of the axes on such a graph and the present invention makes use of this discovery.

According to a first aspect of this invention a method of calibrating a coin validation apparatus including a coin testing section and a programmable memory comprises subjecting two tokens successively to a coin test using the coin testing section to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section, comparing these determined parameter values for the two tokens with standard values of the parameter signals for the two tokens and computing from the determined parameter values and the standard values calibration factors relevant to that particular coin testing section, then operating on standard values of the parameter signals for a set of coins to be used with the coin validation apparatus using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section, and programming the programmable memory with these computed individual reference values.

Once the calibration factors for any particular coin testing section have been derived, the calibration factors that are obtained are appropriate irrespective of the nature or currency of the coins with which the apparatus is to be used. Consequently, the memory of the coin validation apparatus can be programmed for coins of any number of denominations and coins of any currency by simply determining the appropriate calibration factors from the two tokens and then operating on standard values for any particular coins of any particular currency using these calibration

factors. No matter how many coins are present in the set of coins of any particular currency, all that is required to determine the calibration factors and calibrate the apparatus are the tests on two simple tokens. The tokens are produced specifically as calibration tokens and thus do not look like coins and so are not likely to be mistaken or exchanged with coins without this being immediately apparent. The tokens are not accepted by the validation apparatus as valid coins and the tokens have no intrinsic value other than that of being calibration tokens. Consequently they are not likely to get lost or exchanged for coins. The calibration tokens do not have to mirror any particular coin in their magnetic and electrical parameters although naturally they must have broadly similar parameters and so be formed of metal discs.

According to a second aspect of this invention an apparatus for calibrating a coin validation apparatus including a coin testing section and a programmable memory comprises two tokens, a programmed memory containing standard values of the parameter signals for the said two tokens and standard values for coins acceptable to the validation apparatus, and computer means programmed to accept from the coin testing section determined values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section, to compare these determined parameter values for the said two tokens with the standard values of the parameter signals for the two tokens stored in the programmed memory, to compute from the determined parameter values and from the standard values of the parameter signals for the two tokens, calibration factors relevant to the coin testing section of that particular coin validation apparatus, to operate on

the standard values of the parameter signals for the coins acceptable to the coin validation apparatus stored in the programmed memory using the computed calibration factors to compute individual reference values of the parameter signals for each coin acceptable to the coin validation apparatus appropriate for that particular coin testing section, and to program the programmable memory of the coin validation apparatus with these computed individual reference values of the parameter signals.

The apparatus in accordance with the second aspect of this invention is usually referred to as a calibration unit and preferably comprises a microprocessor forming the computer means coupled to the programmed memory. This microprocessor is preferably of the same type as that used in the coin validation apparatus and, during calibration of the apparatus it replaces that normally used in the coin validation apparatus. Of course, the microprocessor in the calibration unit is programmed differently from that normally used in the apparatus. The tokens, the programmed microprocessor and the programmed memory form a readily portable assembly which can be transported to any site at which the coin validation apparatus is situated to enable the coin validation apparatus to be programmed on site.

According to a third aspect of this invention a coin validation apparatus includes a coin testing section for testing a coin and determining the values of two parameter signals which are characteristic of the effect of the coin on the coin testing section, a programmable memory for storing individual reference values of the parameter signals corresponding to valid coins acceptable to the coin validation apparatus, two tokens, a programmed memory containing standard values of the parameter signals for the said two tokens and standard values of the parameter signals for coins acceptable to the coin valid-

ation apparatus, and computer means programmed to accept from the coin testing section determined values of the two parameter signals for each token which are characteristic of the effect of each token on the coin testing section, to compare these determined parameter values for the two tokens with the standard values of the parameter signals for the two tokens stored in the programmed memory, to compute from the determined parameter values and from the standard values of the parameter signals for the two tokens calibration factors relevant to the coin testing section of that particular coin validation apparatus, to operate on the standard values of the parameter signals for the coins acceptable to the coin validation apparatus stored in the programmed memory using the computed calibration factors to compute individual reference values of the parameter signals for each coin acceptable to the coin validation apparatus appropriate for that particular coin testing section, and to program the programmable memory of the coin validation apparatus with these computed individual reference values of the parameter signals.

Such a coin validation apparatus may be formed by a coin validation apparatus including the calibration apparatus or calibration unit in accordance with the second aspect of this invention, or alternatively, the coin validation apparatus may include the means to calibrate it as a permanent part of the coin validation apparatus. In this latter case, the computer means for calibrating the apparatus is preferably the same microprocessor as is used in the coin validation apparatus to control the apparatus and to analyse the output of the coin test section. There is some additional means provided to initiate the calibration sequence, for example in response to the actuation of a switch or in response to the first coin or token introduced when the programmable

memory is in its virgin state.

The standard values of the parameter signals for the tokens and for the coins acceptable to the coin validation apparatus contained in the programmed memory may correspond to the exact values of the parameter signals emitted by a standard coin test section, but preferably they are presented in a modified form to facilitate the computation to be performed by the computer means. Provided that the standard values of the parameter signals for the said two tokens and the standard values for the coins acceptable to the coin validation apparatus are all modified in the same way, for example by all being divided by the same number, then when the calibration factors are computed during the calibration sequence this modification of the standard values is taken account of in the calculation of the calibration factors.

A particular example of a method and apparatus in accordance with this invention will now be described with reference to the accompanying drawings; in which:-

Figure 1 is a block diagram of a coin validation apparatus to be calibrated;

Figure 2 is a block diagram of the calibration system in operation;

Figure 3 is a further block diagram of the apparatus; and,

Figure 4 is a flow chart of a computer program for use in the calibration apparatus.

A typical coin validation apparatus is described in our earlier European Patent Application No 82301161.4 which was filed in the European Patent Office on 8th March 1982.

This coin validation apparatus can be most simply thought of as comprising three separate parts namely a coin test section 1, a microprocessor 2 which controls the coin validation apparatus and performs an analysis on the

output of the coin test section, and a programmable read only memory PROM 3 which, once the coin validation apparatus has been calibrated, contains reference values of coins acceptable to the coin validation apparatus. The coin test section 1 of the coin validation apparatus described in our earlier Patent Application referred to above comprises an electrical coil connected in a resonant feedback circuit of an oscillator. The coin to be tested is placed adjacent the coil and the presence of a coin adjacent the coil influences the inductance and loss factor of the coil and hence influences the oscillation frequency and amplitude of the resonant feedback circuit of the oscillator. The coin test section 1 emits two parameter signals for each coin and these two parameter signals are characteristic of the effect of the coin on the inductance and loss factor of the coil.

These parameter signals are compared with reference signals located in the PROM 3 by the microprocessor 2 and then the microprocessor 2 emits a valid or reject coin signal depending upon whether the values of the parameter signals obtained from the coin test section 1 correspond to those in the PROM 3 or not. The microprocessor preferred for this function is type RCA 1802 manufactured by Radio Corporation of America.

Values of components, their electrical tolerances and the exact size and location of the elements forming the coin test section 1 of the apparatus cause the exact value of the parameter signal output by the coin test section 1 to vary from one piece of apparatus to another, generally similar, piece of apparatus. Thus it is necessary to program the PROM 3 with individual reference values for the coins that are to be acceptable to the coin validation apparatus corresponding to the particular idiosyncracies of the coin test section 1.

The preferred way of calibrating such a coin valid-

ation apparatus is to use a calibration unit consisting of two reference tokens A and B (not shown), a programmed microprocessor 4 which is again of RCA type 1802, and a programmed read only memory PROM 5 containing standard values of the parameter signals corresponding to calibration tokens A and B and corresponding to each of the coins with which the apparatus is to be used. For example, a 50p coin, a 10p coin, a 5p coin and a 2p coin. The parameter signals output from the coin test section 1 of the coin validation apparatus described in our earlier patent specification has the form of variable frequency signals. Table I shows the frequencies of typical output signals from the coin test section 1 for the calibration tokens A and B and the coins.

TABLE I

	Frequencies of typical parameter signals	
	Inductance Frequency (x)	Loss Factor Frequency (y)
Calibration Token A	$A_{(x)}$ 1479Hz	$A_{(y)}$ 993Hz
Calibration Token B	$B_{(x)}$ 4422Hz	$B_{(y)}$ 1999Hz
50p coin	$50_{(x)}$ 4319Hz	$50_{(y)}$ 2748Hz
10p coin	$10_{(x)}$ 3315Hz	$10_{(y)}$ 2433Hz
5p coin	$5_{(x)}$ 645Hz	$5_{(y)}$ 917Hz
2p coin	$2_{(x)}$ 2948Hz	$2_{(y)}$ 660Hz

The values of the calibration tokens A and B are the most significant as they are used for calibration of the apparatus and inspection of Table I shows that the values of the parameter to signals of tokens A and B are in an approximate 3:1 ratio. Using a microprocessor such

as the RCA type 1802 it is desirable to be able to operate on information using only 8 bits of binary data i.e. on numbers in a range from 0 to 255. Bearing this in mind, suppose calibration token A is given values of 32 and 32 and calibration token B values of 96 and 96 then both the sum and the difference of these values are exact multiples of 2. Giving the tokens A and B these values will greatly simplify the calculations to be performed by the microprocessor 4 as any binary multiplications or divisions on multiples of 2 only require the operand to be shifted to the left or right within the operation register of the microprocessor 4. Having thus chosen the standard values that are to be used as the parameters for calibration tokens A and B the typical values shown in Table I have to be modified to apply a similar modification to the values for each signal for each of the coins. Thus, the standard values of the parameter signals of the tokens and coins that are to be used and stored in PROM 5 are shown in Table II. All of the values in Table II are whole numbers in a range from 0 to 255 and thus can be readily handled by the microprocessor 4.

TABLE II

	Standard Parameter Signals	
	Inductance Value x	Loss Value y
Calibration token A	$x_A = 32$	$y_A = 32$
Calibration Token B	$x_B = 96$	$y_B = 96$
50p coin	$x_{50} = 94$	$y_{50} = 144$
10p coin	$x_{10} = 72$	$y_{10} = 125$
5p coin	$x_5 = 14$	$y_5 = 27$
2p coin	$x_2 = 16$	$y_2 = 11$

To calibrate the PROM 3, the microprocessor 2 is replaced by the microprocessor 4 and PROM 5 and then calibration token A is inserted into the coin test section. Typically a push button switch is also actuated such as switch 1 shown in Figure 3, to inform the microprocessor 4 that a calibration token is being inserted or, alternatively, the operation can be triggered automatically for the first coin or token that enters the coin test section 1 when the PROM 3 is in its virgin or unprogrammed state. The coin test section 1 performs its standard testing operations on the calibration token A and two parameter signals are produced by and output from the coin test section 1 into the microprocessor 4. The values of these determined parameter signals are then stored in an internal memory of the microprocessor 4. Token A is then rejected and calibration token B inserted into the coin test section 1. A push button switch such as switch 2 shown in Figure 3 is also actuated to inform the microprocessor that token B has been inserted or if the calibration sequence is triggered automatically then the microprocessor 4 expects the next token to be token B. The coin test section 1 then performs its tests on reference token B and again determined values of the parameter signals are output into the microprocessor 4 where they are stored in an internal memory. The microprocessor then compares the determined parameter signal values for the calibration tokens A and B with the standard values for the calibration tokens shown in Table II which it draws from the PROM 5. From these reference values it computes calibration factors a, b, c and d using an algorithm derived as follows.

As mentioned earlier the reference values of the parameter signals can be thought of as representing co-ordinates of points on a graph having the inductance values along one axis - say the X axis and the loss factor

values along the other axis - say the Y axis. In this case the calibration factors (a, b, c and d) are used to define the offset to be applied to the origin of the axes - factors a and c, and the scaling factors to be applied to the axes - factors b and d. Thus if $A_{(x)}$ and $A_{(y)}$ are the determined parameter signal values for the calibration token A, $B_{(x)}$ and $B_{(y)}$ are the determined parameter signal values for the calibration token B, and x_A and y_A are the standard values of the parameter signals for calibration token A and x_B and y_B are the standard parameter signals from reference token B then:-

$$A_{(x)} = a + b.x_A \quad \ldots (1)$$
$$A_{(y)} = c + d.y_A \quad \ldots (2)$$
$$B_{(x)} = a + b.x_B \quad \ldots (3)$$
$$B_{(y)} = c + d.y_B \quad \ldots (4)$$

Calibration factor a is equal to the offset of the X axis of the graph, b is the scaling factor of the X axis, calibration factor c is the offset on the Y axis and calibration factor d is the scaling factor of the Y axis. Then, from equations (1) and (3),

$$b = \frac{A_{(x)} - B_{(x)}}{x_A - x_B} \qquad \ldots (5)$$

and

$$a = A_{(x)} - x_A . \left(\frac{A_{(x)} - B_{(x)}}{x_A - x_B} \right) \qquad \ldots (6)$$

and similarly from equations (2) and (4)

$$d = \frac{A_{(y)} - B_{(y)}}{y_A - y_B} \qquad \ldots (7)$$

and

$$c = A_{(y)} - y_A . \left(\frac{A_{(y)} - B_{(y)}}{y_A - y_B} \right) \qquad \ldots (8)$$

The computed values of these correction factors a, b, c and d are again stored in an internal memory of the microprocessor 4. The microprocessor 4 then computes in respect of each of the standard parameter signal values of the set of coins contained in the PROM 5 the individual reference values for the parameter signals of each of the coins appropriate to that particular coin test section 1, and programs these into the PROM 3. To do this, the microprocessor 4 uses an algorithm derived as follows:-

Let $50_{(x)}$ be the individual reference value for the inductance value of a 50p coin required to be programmed into the PROM 3 and let x_{50} be the standard value (shown in Table II) contained in the PROM 5. Then, by an equation similar to equations 1 to 4

$$50_{(x)} = a + b.x_{50} \qquad \ldots (9)$$

$$50_{(y)} = c + d.y_{50} \qquad \ldots (10)$$

Also let Δ_{50} be the difference between $50_{(x)}$ and x_{50}. Thus from equations 9, 5 and 6,

$$\Delta_{50} = A_{(x)} - x_A \cdot \left(\frac{A_{(x)} - B_{(x)}}{x_A - x_B}\right) + \left(\frac{A_{(x)} - B_{(x)}}{x_A - x_B}\right) x_{50} - x_{50} \qquad \ldots (11)$$

However, we know that $x_A = 32$ and $x_B = 96$ from Table II. So,

$$\Delta_{50} = \frac{3A_{(x)}}{2} - \frac{B_{(x)}}{2} - \frac{x_{50}}{64}\left\{A_{(x)} - B_{(x)} - 64\right\} \qquad \ldots (12)$$

then let

$$\delta_A = A_{(x)} - x_A \quad \text{and} \quad \delta_B = B_{(x)} - x_B$$

so

$$\Delta_{50} = \frac{x_{50}}{64}(\delta_A - \delta_B) + \frac{3}{2}\delta_A - \frac{\delta_B}{2}$$

then let

$$p = \delta_A - \delta_B \text{ and } q = \delta_A - \delta_B + 2\delta_A$$

$$p = A_{(x)} - B_{(x)} + 64, \quad q = 2.(A_{(x)} - 32) + p$$

so

$$\Delta_{50} = \left(\frac{-x_{50} \cdot p}{64} + \frac{q}{2}\right) \qquad \ldots (13)$$

A similar algorithm can be derived for the y axis 50p coin value and for the x and y values of each of the other coins. The computer solves equation 13 and the equivalent one for the y axis using of course the derived parameter signal values from the tokens A and B for the values of $A_{(x)}$, $A_{(y)}$, $B_{(x)}$, $B_{(y)}$ and substitutes the value from the PROM 5 for the X_{50} and Y_{50}. The computer then derives the individual reference values $50_{(x)}$ and $50_{(y)}$ and loads these values into the PROM 3. The process is repeated for each of the other coins.

The microprocessor 4 and PROM 5 are removed after the PROM 3 has been programmed and the original microprocessor 2 replaced to provide a complete and calibrated coin validation apparatus as shown in Figure 1.

C L A I M S

1. A method of calibrating a coin validation apparatus including a coin testing section and a programmable memory comprising subjecting two tokens successively to a coin test using the coin testing section to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section, comparing these determined parameter values for the two tokens with standard values of the parameter signals for the two tokens and computing from the determined parameter values and the standard values calibration factors relevant to that particular coin testing section, then operating on standard values of the parameter signals for a set of coins to be used with the coin validation apparatus using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section, and programming the programmable memory with these computed individual reference values.

2. A method according to claim 1, in which the calibration sequence is initiated in response to the first coin or token introduced when the programmable memory is in its virgin state.

3. A method according to claim 1 or 2, in which the standard values of the parameter signals for the tokens and for the coins acceptable to the coin validation apparatus contained in the programmed memory do not correspond to the exact values of the parameter signals emitted by a standard coin test section but are presented in a modified form to facilitate the computation to be performed, the modification of the standard values being taken account of in the calculation of the calibration factors.

4. A calibration unit for calibrating a coin validation apparatus including a coin testing section (1) and a programmable memory (3) comprising two tokens, a programmed memory (5) containing standard values of the parameter signals for the said two tokens and standard values for coins acceptable to the validation apparatus, and computer means (4) programmed to accept from the coin testing section (1) determined values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section (1), to compare these determined parameter values for the said two tokens with the standard values of the parameter signals for the two tokens stored in the programmed memory (5), to compute from the determined parameter values and from the standard values of the parameter signals for the two tokens, calibration factors relevant to the coin testing section (1) of that particular coin validation apparatus, to operate on the standard values of the parameter signals for the coins acceptable to the coin validation apparatus stored in the programmed memory (5) using the computed calibration factors to compute individual reference values of the parameter signals for each coin acceptable to the coin validation apparatus appropriate for that particular coin testing section (1), and to program the programmable memory (3) of the coin validation apparatus with these computed individual reference values of the parameter signals.

5. A calibration unit according to claim 4, which comprises a microprocessor (4) forming the computer means coupled to the programmed memory (5), the microprocessor (4) being of the same type as that (2) used in the coin validation apparatus, during calibration of

the apparatus the microprocessor (4) replacing the microprocessor (2) normally used in the coin validation apparatus.

6. A coin validation apparatus including a coin testing section (1) for testing a coin and determining the values of two parameter signals which are characteristic of the effect of the coin on the coin testing section (1), a programmable memory (3) for storing individual reference values of the parameter signals corresponding to valid coins acceptable to the coin validation apparatus, two tokens, a programmed memory (5) containing standard values of the parameter signals for the said two tokens and standard values of the parameter signals for coins acceptable to the coin validation apparatus, and computer means (4) programmed to accept from the coin testing section (1) determined values of the two parameter signals for each token which are characteristic of the effect of each token on the coin testing section (1), to compare these determined parameter values for the two tokens with the standard values of the parameter signals for the two tokens stored in the programmed memory (5), to compute from the determined parameter values and from the standard values of the parameter signals for the two tokens, calibration factors relevant to the coin testing section (1) of that particular coin validation apparatus, to operate on the standard values of the parameter signals for the coins acceptable to the coin validation apparatus stored in the programmed memory (5) using the computed calibration factors to compute individual reference values of the parameter signals for each coin acceptable to the coin validation apparatus appropriate for that particular coin

testing section (1), and to program the programmable memory (3) of the coin validation apparatus with these computed individual reference values of the parameter signals.

7. A coin validation apparatus according to claim 6, in which the computer means (4) for calibrating the apparatus is the same microprocessor as is used in the coin validation apparatus to control the apparatus and to analyse the output of the coin test section (1).

8. An apparatus according to claim 7, also including means to initiate the calibration sequence in response to the actuation of a switch or in response to the first coin or token introduced when the programmable memory is in its virgin state.

Fig.1.

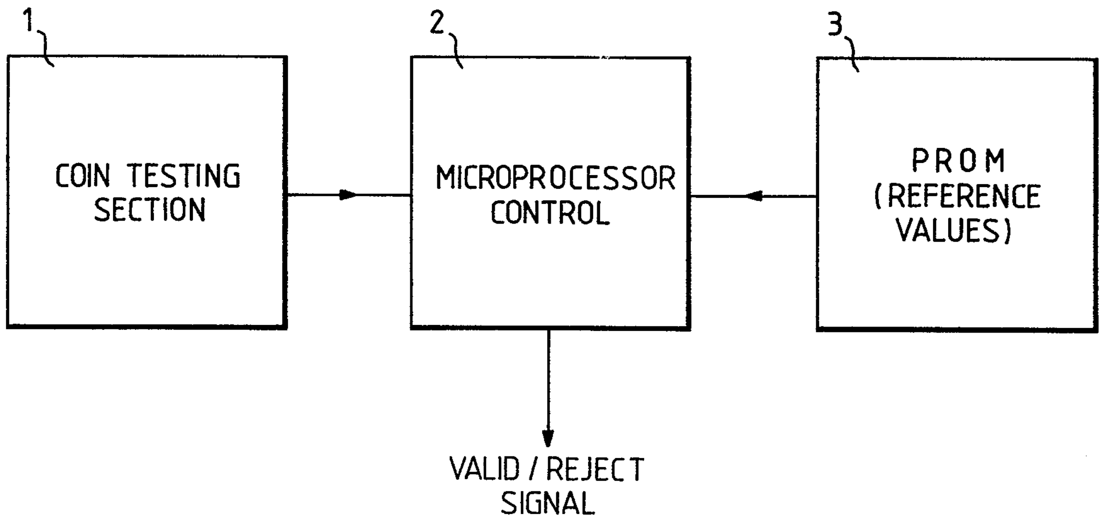

1
2
3
COIN TESTING SECTION
MICROPROCESSOR CONTROL
PROM (REFERENCE VALUES)
VALID / REJECT SIGNAL

Fig.2.

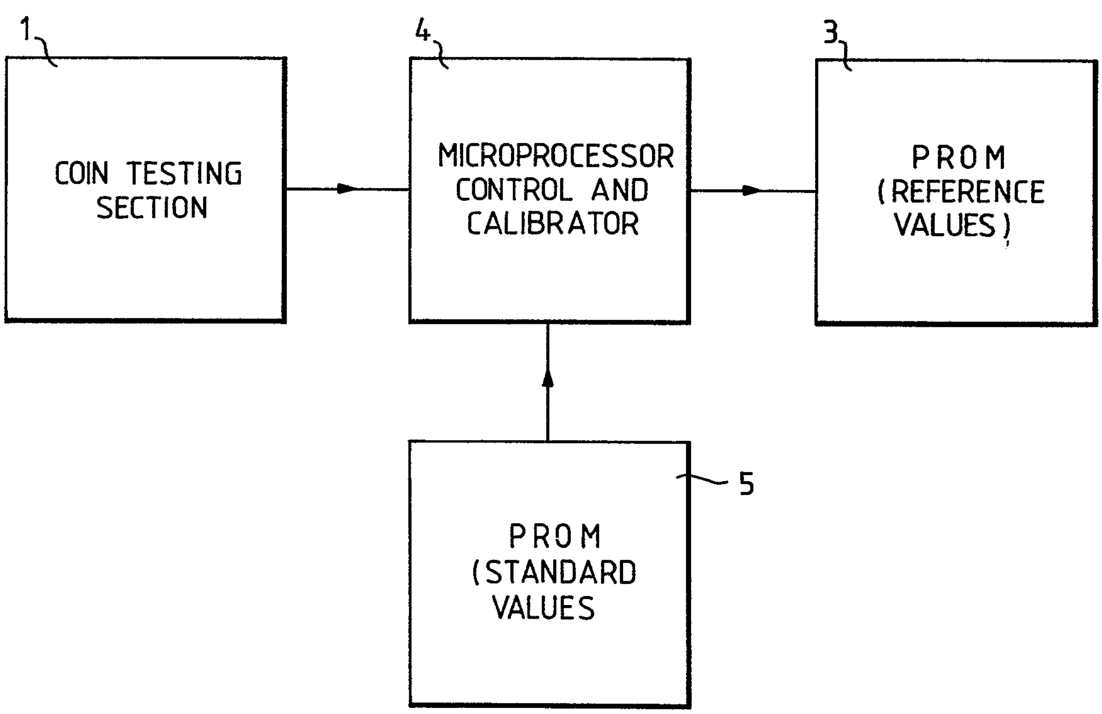
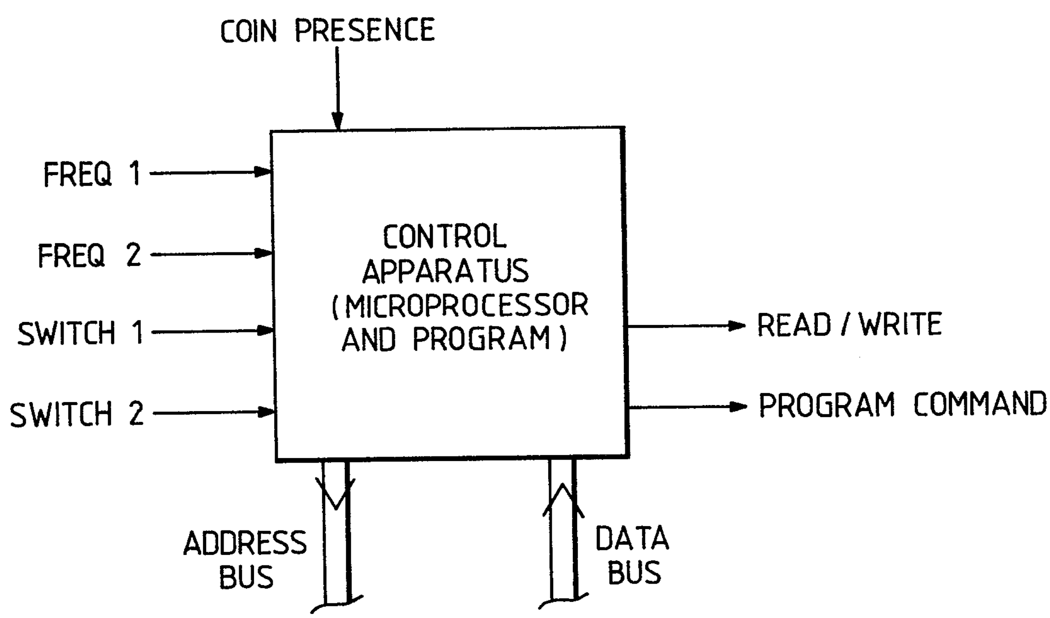
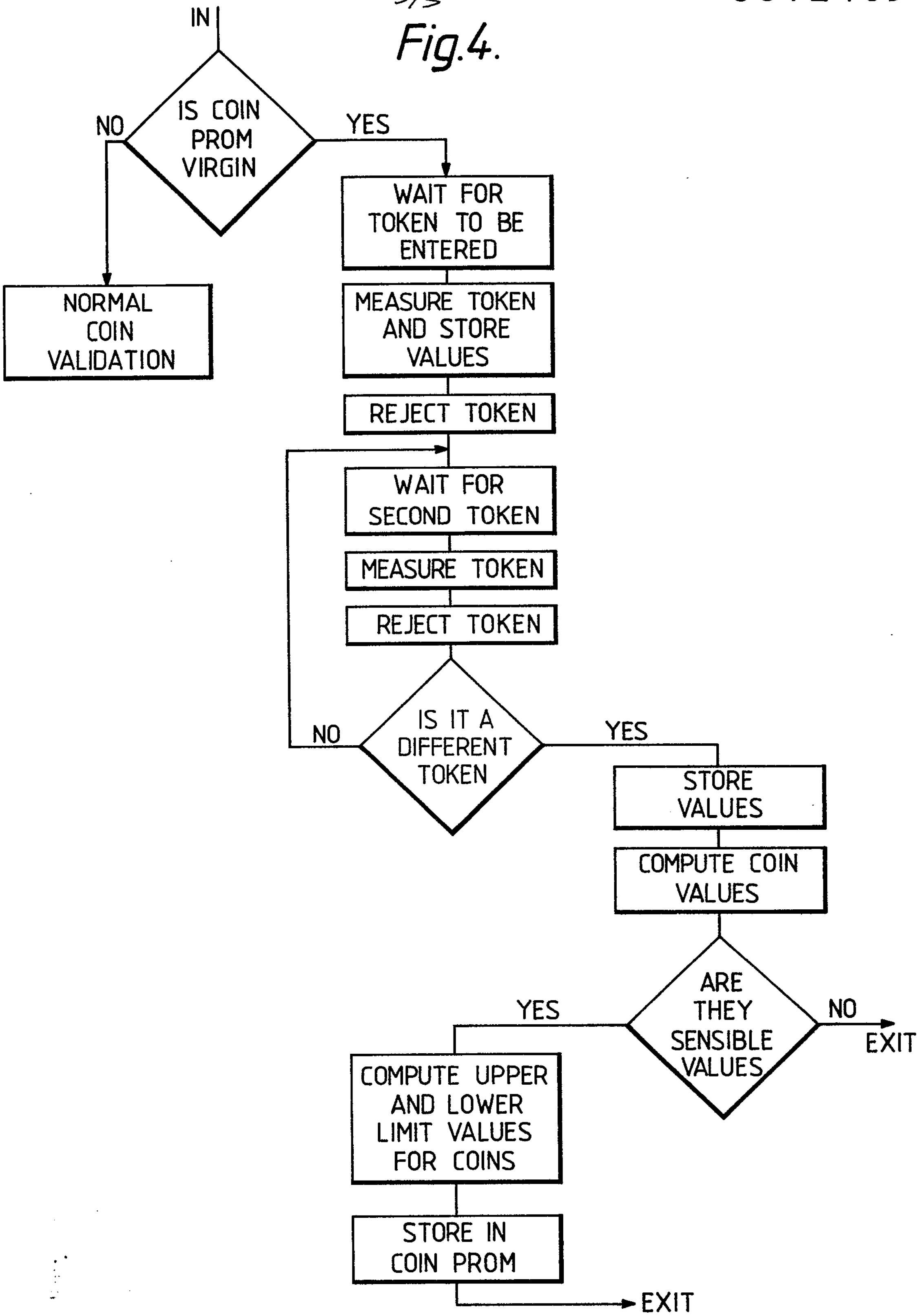

1
4
3
COIN TESTING SECTION
MICROPROCESSOR CONTROL AND CALIBRATOR
PROM (REFERENCE VALUES)
5
PROM (STANDARD VALUES

Fig.3.


COIN PRESENCE
FREQ 1
FREQ 2
SWITCH 1
SWITCH 2
CONTROL APPARATUS (MICROPROCESSOR AND PROGRAM)
READ / WRITE
PROGRAM COMMAND
ADDRESS BUS
DATA BUS

0072189

Fig.4.



PUB-NO: EP000072189A2

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INVENTOR-INFORMATION:

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NAME	COUNTRY
AERONAUTICAL GENERAL INSTR	GB

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ABSTRACT:

CHG DATE=19990617 STATUS=O> A method of

calibrating a coin validation apparatus including a coin testing section (1) and a programmable memory (3) comprises subjecting two tokens successively to a coin test using the coin testing section (1) to determine the values of two parameter signals for each token which are characteristic of the effect of each token on the coin testing section (1). These determined parameter values for the two tokens are then compared with standard values of the parameter signals for the two tokens, and from the determined parameter values and the standard values, calibration factors relevant to that particular coin testing section (1) are computed. Standard values of the parameter signals for a set of coins to be used with the coin validation apparatus are then operated on using the computed calibration factors to compute individual reference values of the parameter signals for each coin in the set appropriate for that particular coin testing section (1). Finally, the programmable memory (3) is programmed with these computed individual reference values. An apparatus for performing this method includes two tokens, a programmed memory (5) containing standard values of the parameter signals for the said two tokens and standard values for coins acceptable to the validation apparatus, and a programmed computer (4).